

Erratum to

LHCb Collaboration

DOI:

[10.1007/JHEP05\(2019\)076](https://doi.org/10.1007/JHEP05(2019)076)

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Document Version

Publisher's PDF, also known as Version of record

Citation for published version (Harvard):

LHCb Collaboration 2019, 'Erratum to: Measurement of Υ production in pp collisions at $\sqrt{s} = 13$ TeV (Journal of High Energy Physics, (2018), 2018, 7, (134), 10.1007/JHEP07(2018)134)', *Journal of High Energy Physics*, vol. 2019, no. 5, 76. [https://doi.org/10.1007/JHEP05\(2019\)076](https://doi.org/10.1007/JHEP05(2019)076)

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Erratum: Measurement of Υ production in pp collisions at $\sqrt{s} = 13$ TeV



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ERRATUM TO: [JHEP07\(2018\)134](#)

ARXIV EPRINT: [1804.09214](#)

The top plot shown in figure 3 of ref. [1] is the result of 8 TeV. The correct figure is given below in figure 3:

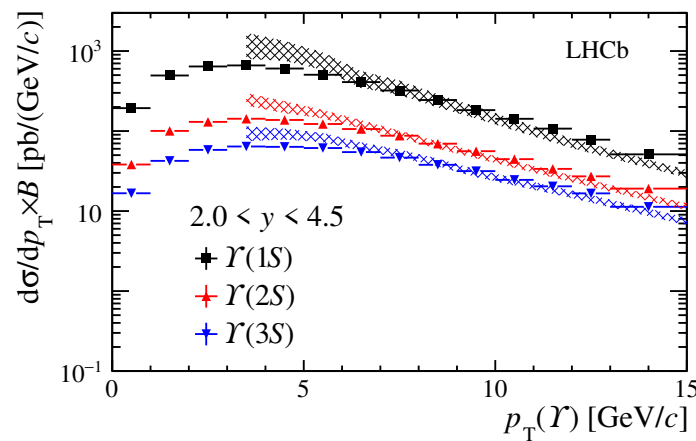


Figure 3. Differential cross-sections multiplied by dimuon branching fractions for the $\Upsilon(1S)$ (black solid squares), $\Upsilon(2S)$ (red upward triangles) and $\Upsilon(3S)$ (blue downward triangles) states versus p_T integrated over y between 2.0 and 4.5. Statistical and systematic uncertainties are added in quadrature. Predictions from NRQCD [2] for the $\Upsilon(1S)$ (black grid shading), $\Upsilon(2S)$ (red grid shading) and $\Upsilon(3S)$ (blue grid shading) states are overlaid in the plot.

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References

- [1] LHCb collaboration, *Measurement of Υ production in pp collisions at $\sqrt{s} = 13$ TeV*, *JHEP* **07** (2018) 134 [[arXiv:1804.09214](https://arxiv.org/abs/1804.09214)] [[INSPIRE](#)].
- [2] Y. Feng, B. Gong, L.-P. Wan and J.-X. Wang, *An updated study of Υ production and polarization at the Tevatron and LHC*, *Chin. Phys. C* **39** (2015) 123102 [[arXiv:1503.08439](https://arxiv.org/abs/1503.08439)] [[INSPIRE](#)].

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